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Original Article

Effectiveness of a serious game on the self-concept of children with visual impairments: A randomized controlled trial



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ABSTRACT

Background: Young children with visual impairments (VIs) are at high risk for mental disorders, due to victimization and subsequent social withdrawal. Children with VIs have been shown to have a poorer self-concept and lower general psychosocial well-being compared with peers without VIs.

Objective: The objective of this study was to examine the effectiveness of a serious game to improve psychosocial outcomes in children with VIs.

Methods: A randomized controlled trial was conducted to evaluate the effectiveness of the computer game *See for children* with VIs. The game was developed based on rational-emotive behavioral therapy principles, with the aim of addressing self-concept (academic, social, and general), psychosocial well-being (social inclusion, exclusion, and emotions), and coping strategies (approach, avoidance). Sixty-four children aged 6–8 years were randomized to the intervention group, who played the game, or a control group, who received care-as-usual (CAU).

Results: Our results showed that children with VIs who played the serious game scored significantly higher on academic self-concept and social inclusion compared with the control group. Furthermore, children rated the game positively, suggesting the desirability, validity, and feasibility of the intervention.

Conclusions: The results provide preliminary evidence that a serious game can enhance psychosocial outcomes in children with VIs. This approach might also promote positive educational outcomes, such as academic achievement, and reduce the stigma of therapy for children with VIs. Implications and future directions are discussed.

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According to the World Health Organization (WHO),¹ 19 million children worldwide live with a visual impairment (VI), ranging from poor vision to blindness. This global problem has become one of the top five priorities of the WHO, which launched the initiative “Vision 2020: The Right to Sight” to eliminate avoidable blindness,

in a joint program with the International Agency for the Prevention of Blindness.¹ Although numerous medical treatments for vision correction are available,² living with a VI imposes great physical,³ social,^{4,5,6} and psychological^{7,8} burdens on children and families, particularly during early development.

Studies have shown that children with VIs may experience poorer motor competence compared with typically sighted children,^{9,10} which in turn may lead to withdrawal from physical activities and social exclusion.¹¹ However, even when children with VIs show physical competency similar to that of peers without VIs, they may still engage in fewer physical activities.⁷ This has been mainly attributed to environmental barriers, fear of injury, and stigma.¹² Indeed, children with VIs are at 80% greater risk for peer victimization, compared with peers without VIs.¹³ As a result of victimization and a lack of adaptive coping strategies, children with

Abbreviations: REBT, Rationale Emotive Behavior Therapy; SDQ-I, Self-Description Questionnaire; HRQOL, Health-Related Quality of Life; PERIK, Social Emotional Well-being and Resilience of Children in Early Childhood Settings Scale.

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VIs limit social participation,¹⁴ which in turn may impact their quality of life and well-being.¹⁵ Due to the burden they experience, individuals with VIs are found to be at higher risk for mental disorders.¹⁶ Likewise, children with VIs might develop a negative sense of competence and a poor self-concept, potentially due to their perception of how others see them.¹⁷

As limited exploration of physical and social environments leads to a poor self-concept,¹⁸ children with VIs are at higher risk for poor self-concepts. Indeed, it has been shown that children with VIs hold more negative social, physical, and academic self-concepts compared with classmates without VIs.^{7,19} Considering the challenges that children with VIs experience and the long-lasting detrimental effects on their social-emotional and physical development, it becomes imperative that they receive adequate support during early childhood. Interventions should promote positive psychosocial outcomes and ensure that children with VIs are equipped with adaptive coping strategies.

Existing interventions for children with VIs typically include techniques from rational-emotive behavioral therapy (REBT).²⁰ REBT is a form of psychoeducational therapy addressing emotional and behavioral problems and aiming to empower individuals by advocating self-acceptance and love of oneself, thereby enabling individuals to live happier and fulfilling lives.²¹ Specifically, studies have shown that REBT is an effective intervention for improving psychological well-being in individuals with VIs²² and improving the self-concept of adolescents with VIs.²³ In addition, a meta-analysis²⁴ revealed that REBT had a moderate-to-high effect on emotional and behavioral outcomes, including self-concept, among children and adolescents with VIs. However, despite the availability and the positive effects of REBT interventions, up to 60% of children with VIs do not engage in any form of care aimed at psychosocial well-being,²⁵ due to stigma.²⁶ Accordingly, to foster more uptake of REBT interventions among children with VIs, there is a need to design interventions that appeal to children.

One possible way to appeal to children is to offer interventions in the form of serious games. Serious games are alternative educational or psychotherapeutic tools that go beyond mere entertainment, aiming to enable learning in an interactive, digital fashion.²⁷ Playing a serious game actively engages the player and promotes change within a safe virtual environment. Furthermore, players receive feedback as they play and are encouraged to try different problem-solving strategies in the game. There is ample evidence for the efficacy of serious games. Serious games have been found to be effective in health care^{28,29} and in educational settings³⁰ by improving skills and psycho-educational outcomes. Furthermore, a recent study³¹ indicated that an REBT-based serious game provided an effective therapeutic tool for improving emotional symptoms and emotion regulation in young children when delivered as a resiliency program in schools. In addition, there is evidence that serious games are related to higher satisfaction levels than traditional interventions. For example children reported more satisfaction in playing the game as compared with a typical face-to-face intervention, potentially due to the appealing interactive features of the game.³¹

In order to develop an intervention that employs evidence-based REBT techniques and at the same time is likely to appeal to children, we developed an REBT-based serious game for children with VIs. The serious game *See* is structured in 10 modules, with the aim of addressing difficulties encountered by children with VIs on a daily basis at school, and hence to improve their coping strategies and promote more positive beliefs about themselves. Thus, the goal was to enable children with VIs to address self-concept, psychosocial well-being, and coping strategies at school, without the stigma of a standard face-to-face psychotherapeutic intervention.

Current study

The aims of the study were: (1) to assess the effectiveness of the serious game intervention *See* in improving psychosocial outcomes in children with VIs; (2) to evaluate whether the game leads to improvements in self-concept, psychosocial well-being, and coping strategies, compared with a control group; and (3) to investigate children's perception of the serious game and hence the game's validity as an intervention for young users with VIs. This is the first study examining the effectiveness and the social validity of the serious game intervention *See*.

The primary outcome of this study is defined as improving the self-concept and coping strategies in children with mild VIs. We hypothesized that playing the serious game would lead to (a) significant improvements in self-concept (i.e., academic, social, and general); and (b) better coping strategies in dealing with VIs (approach and avoidance), and that these effects would be significantly better than the effects of care-as-usual (CAU). Secondary outcomes included (emotional and social) well-being and social validity. We hypothesized that the game would lead to (c) improvements in (emotional and social) well-being and that it would have (d) high social validity.

Methods

Study design

This study employed a parallel RCT design with two groups. Participants were randomly assigned to either the *See* game intervention or the care-as-usual (CAU) control group with assessments at pre-test (prior to randomization), post-test (4–6 weeks after the intervention), and follow-up (3 months after the intervention). The study was approved by the Scientific and Ethics Review Board of the Faculty of Behavior and Movement Sciences, Vrije Universiteit Amsterdam (VCWE VUVU: VCWE-2016-213).

Intervention: 'see'

See is a web-based serious game intervention program (<http://www.ziejewel.eu/>) designed by the third, fourth, and fifth authors of this study for children aged 6–8 years with VIs who attend mainstream primary school. The game consisted of 10 digital levels, which could have been played all at once consecutively (but this did not occur) or spread across several sessions, within a maximum time of 6 weeks, based on individual preference. Each level was programmed to last 10–20 min and enacted a situation that a child with VI might encounter at school. Accordingly, the game featured five main characters with visual impairments, each of them engaging in several situations with other typically sighted characters, often featuring peers in the classroom. In each of the 10 digital levels, a short animation of a problem that might be encountered in school due to having a VI was shown. Some situations occurred in the classroom, and others took place in the schoolyard. The children analyzed these situations by answering questions about the observed situation, by choosing “helpful thoughts” and giving alternative solutions to the presented problems. Each level consisted of five parts: (1) a short animation of the problem, (2) a song about the specific situation and how it made the player feel, (3) a task involving the selection of helpful and non-helpful thoughts, (4) a task to find matching emotions, and (5) an animation about a helpful thought that might be useful in that specific situation. The first game session with the five parts within the session is illustrated in Fig. 1.

Care-as-usual group

Children in the control group were defined as a waiting-list control group, hereafter care-as-usual (CAU). As is usually done in classrooms in the Netherlands, teachers provided the children with tools (i.e., a magnifier loupe) to enlarge the text when needed. Additionally, children could use a computer to enlarge the letters. No intervention or special care was offered in addition to the commonly offered support for children with VIs in general. At the end of the study, all children in the CAU group were offered the opportunity to play the serious game.

Participants

Sample size. An a priori power analysis (G-power) was performed to estimate the sample size based on a between-subjects repeated measures ANOVA with two groups and three repeated observations. Based on a power ($1-\beta$) of 0.80 and a significance level of 5% (two-sided) and an expected small-to-moderate sample size ($f = 0.3$), a sample of 80 participants, with 40 participants per group, was estimated. With an expected dropout rate of 10%, we aimed to recruit 88 participants, with 44 in each group.

Recruitment. The inclusion criteria were: (a) children attending regular primary school in the Netherlands, (b) age between 6 and 8 years, and (c) a VI visual acuity of less than 0.3 and more than 0.05 in the best eye or a visual field limitation of below 30° (according to WHO norms). Itinerant teachers from the Dutch national organizations, Bartiméus and Royal Dutch Visio, selected a list of pupils with VIs that met the inclusion criteria for this study. VIs were diagnosed by trained ophthalmologists working at two national organizations. All parents of eligible children in this age range in the Netherlands who are known at one of the two national organizations providing services for persons with VI received a letter that explained the aims and study procedures and invited their children to participate in the study. In order to participate in this study, parents and children needed to sign informed consent letters. A total of 74 informed consent letters were returned, but 10 children did not complete the study ($n = 3$ did not meet the inclusion criteria, $n = 2$ no longer received care from Bartiméus or

Royal Dutch Visio, $n = 3$ withdrew from the study due to other treatments and tests, and $n = 2$ missed the first appointment). The final sample consisted of 64 children with VIs (mean age = 6.88 years; 22 girls) who were attending regular primary schools. Demographic information about the sample is displayed in Table 1. Chi-square analyses revealed non-significant differences between the intervention ($n = 30$) and the control group ($n = 34$) for demographic characteristics (gender, age, ethnicity; all $p > .368$), suggesting that the two groups were comparable.

Procedure and randomization

First, schools provided their approval. Next, parents and children were asked for written informed consent. All the schools that were approached agreed to participate. All the forms used in the study were adapted for children with VIs by using enlarged letters. Children were given the alternatives of reading the form themselves or having a trained research assistant read it aloud for them, while sitting in a private room at school. All the assessments were conducted face-to-face with an independent researcher. The duration of conducting each assessment was about 60 min, with breaks included according to the child's needs. After signing the informed consent forms, all included children underwent pre-test (T0) assessments conducted by independent researchers (psychologists and a therapist from the specialized organization for persons with a VI, Bartiméus who did not know the children personally but were experienced in the care and support of children with VIs; none of them were authors of this paper). These independent researchers responsible for the assessments were randomly assigned to the schools they visited and they visited the same schools at all time points. Participants were assessed with questionnaires to determine demographic information (Table 1), self-concept, well-being, and coping strategies. After the first assessment (T0), participants were allocated to either the serious game (intervention group) or the control (CAU group). An independent researcher, which was blind to the conditions, conducted the automatic randomization and group allocation via a computerized randomizer program in Graph Pad.³²

At T1, the same independent researchers conducted another

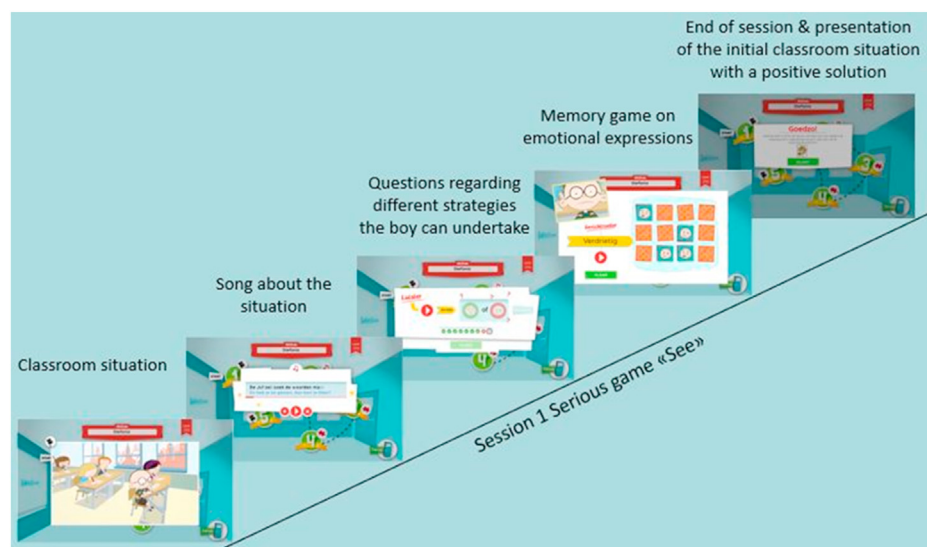


Fig. 1. An illustration of the serious game “See”. The first part describes a classroom situation that presents a difficulty for children with visual impairments; the second part is a song that describes the situation; the third part presents questions to the participant concerning different coping strategies for the situation that the character in the story can adopt; the fourth part presents a game of matching emotional expressions that could potentially be triggered in the described situation; the fifth part presents the initial situation and a positive solution.

Table 1
Characteristics of the study population (n = 64).

Characteristics	Categories	Intervention Group "See"	Control group CAU
Gender	Female	14.1% (n = 9)	15.6% (n = 10)
	Male	25% (n = 16)	20.3% (n = 13)
	Missing ^a	7.8% (n = 5)	17.2% (n = 11)
Age, years	6	10.9% (n = 7)	14% (n = 9)
	7	21.9% (n = 14)	17.2% (n = 11)
	8	6.3% (n = 4)	4.7% (n = 3)
	Missing ^a	7.8% (n = 5)	17.2% (n = 11)
	Bartiméus	26.6% (n = 17)	29.6% (n = 19)
Support from	Royal Dutch Visio	12.5% (n = 8)	6.3% (n = 4)
	Missing ^a	7.8% (n = 5)	17.2% (n = 11)
	European	36% (n = 23)	28.1% (n = 18)
Ethnicity	Chinese	0	3.1% (n = 2)
	Other	3.1% (n = 2)	4.7% (n = 3)
	Missing ^a	7.8% (n = 5)	17.2% (n = 11)

^a n = 16 children were missing demographic information collected by teachers.

round of self-concept, well-being, and coping strategy assessments. Moreover, the social validity of the serious game was assessed in the intervention group. At T2, the same independent researchers conducted the assessments of self-concept, well-being, and coping strategies.

After the follow-up assessments, the control group was given the code to access and play the serious game. A schematic illustration of the RCT design and the measurements performed is shown in Fig. 2.

Measures

Primary outcomes

Self-concept. Self-concept was assessed with the Self-Description Questionnaire.^{33,34} Children independently completed the questionnaire across three domains: social self-concept (6 items, example item: "Most other kids like me"), academic self-concept (6 items, example item: "I am good at all school subjects"), and general self-concept (7 items, example item: "In general, I like being the way I am"). Children responded on a four-point scale, which ranged from 1 (no, never) to 4 (yes, always). The mean of each subscale was computed for the analyses. The internal consistency analysis yielded Cronbach's alpha values of 0.61, 0.84, and 0.74 for the general, academic, and social self-concepts, respectively, comparable to previous work.³⁵ Reliability analyses showed good test-retest reliability for general (ICC = .81), academic (ICC = .84), and social self-concept (ICC = .80).

Coping strategies. Coping strategies were assessed using the Stress and Coping Questionnaire for children.³⁶ This questionnaire measured the emotional responses and coping strategies of children when faced with school-related problems. Originally, the questionnaire was developed for children with asthma. For this study, we adapted the situations in the questionnaire to children with VIs (in collaboration with one of the authors of the original instrument). Four different situations were presented to participants. Each situation described a scenario with difficulties related to VIs that children might deal with at school, for example not being able to join a play group. Participants rated each response on a four-point Likert scale, which ranged from "never" to "very often". In each situation, two ways of coping were described, which represented approach (6 items) and avoidance (8 items). An example item for the approach coping strategy is "Do you try once more?", while one for the avoidance coping strategy is "Do you do something else?". Participants skipped items describing situations that have never been experienced, which resulted in missing values. Therefore, a mean score for each situation and strategy was

calculated. The internal consistency of the scales was acceptable, with Cronbach's alpha values between 0.60 and 0.70, for approach and avoidance, respectively, comparable to scores in primary school children and children with asthma.³⁶ Test-retest reliability scores were poor for both the approach (ICC = .48) and avoidance scales (ICC = .16).

Secondary outcomes

Well-being. We assessed well-being with the Health-Related Quality of Life (HRQOL) questionnaire,^{37,38} which measures the health-related quality of life of children with chronic disorders. The questionnaire consisted of 37 items, each rated on a five-point Likert scale. The HRQOL items covered six dimensions: independence, emotions, social inclusion, social exclusion, limitations, and medication/treatment. For the purpose of this study, 19 questions were included, covering three dimensions: emotions, social inclusion, and social exclusion. Internal consistency was moderate to high, with Cronbach's alpha values of 0.45 for social inclusion, 0.75 for social exclusion, and 0.81 for emotions.

Social validity. To measure the desirability, feasibility, and effectiveness of the intervention, children in the intervention group completed the Social Validity Scale³⁹ questionnaire after the intervention. Items were rated on a five-point Likert scale (range: 1 = very bad to 5 = very good, with a child-friendly smiley-face response system). An example item is "How did you find the video clips of the boys and the girls displayed in the game?". For this study, the original 32-item questionnaire that contained questions for both clients and caregivers was adapted to a more appropriate version that consisted of 16 questions directed to the child only. The mean score for each subscale (desirability, feasibility, effectiveness) was computed for the analyses. The use of the language was checked with children of the same age and adapted where needed. Internal consistency analysis in our study yielded a Cronbach's alpha of .791.

Statistical analyses

To test the effectiveness of the intervention compared with care-as-usual with regard to our primary and secondary outcomes, a two-way repeated-measures ANOVA was performed. The design was 2 between-subjects (Group: serious game, CAU) * 3 within subjects (Time: pre-, post-test, follow-up), with self-concept, coping strategies, and well-being as dependent variables. In order to test the secondary outcome of social validity of the serious game, a one-sample *t*-test was conducted. Analyses were performed at the 0.05 significance level, using SPSS-25.

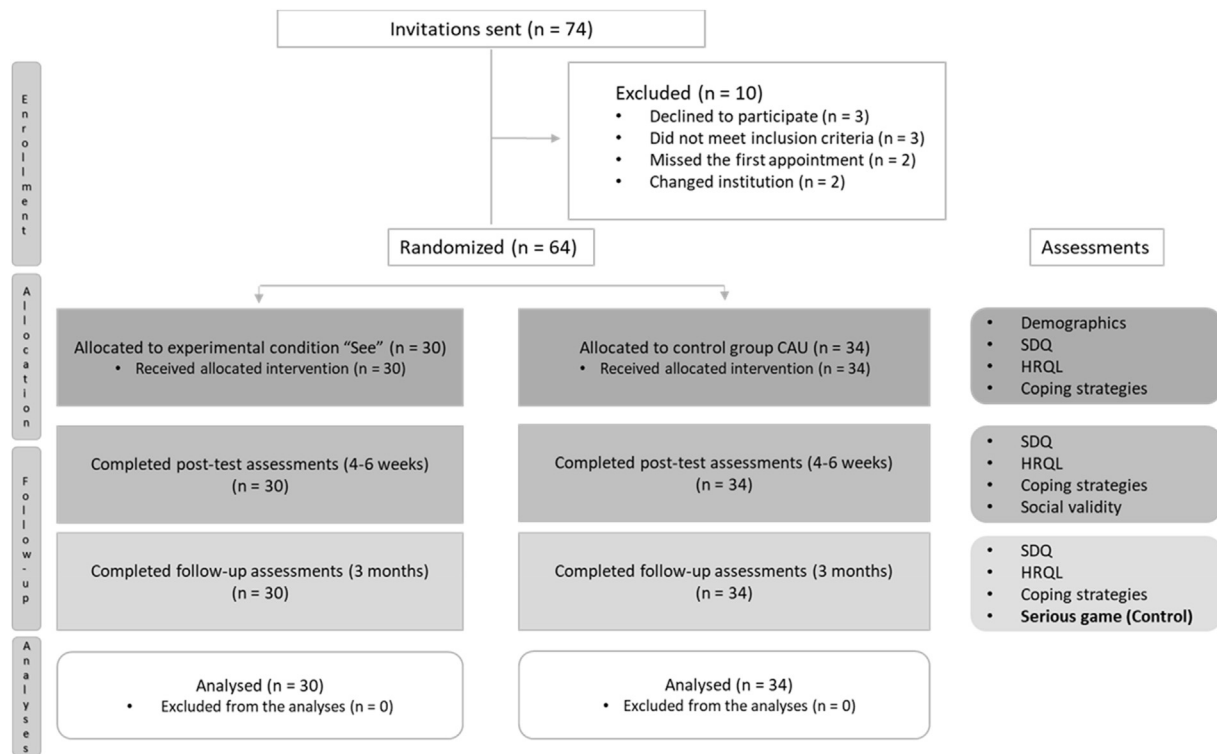


Fig. 2. A schematic illustration of the RCT design and measurements performed. SDQ: Self-description questionnaire, for assessing self-concept; HRQL: health-related quality of life questionnaire, for assessing wellbeing.

Results

Primary outcomes

Self-concept. The two-way repeated-measures ANOVA yielded a significant effect of the interaction between Time (pre-test, post-test, and follow-up) and Group (intervention and control) on the Academic self-concept ($F[2, 61] = 3.69, p = .032, \eta_p^2 = .06$), but not on the Social self-concept ($F[2, 61] = .83, p = .439$) nor the General self-concept ($F[2, 61] = 1.21, p = .306$). Post hoc tests with paired-samples t-tests revealed a non-significant difference from baseline ($M = 3.01, SD = .65$) to post-test ($M = 3.19, SD = .56$) for Academic self-concept ($t[29] = -1.93, p = .063, n = 30$; Fig. 3) in the intervention group.

Secondary outcomes

Coping strategies. The repeated-measures ANOVA revealed a non-significant effect of the interaction between Time (pre-test, post-test, and follow-up) and Group (intervention and control) on Approach ($F[2, 41] = .86, p = .429$) and on Avoidance ($F[2, 37] = 2.16, p = .132$; Fig. 4).

Well-being. The repeated-measures ANOVA yielded a significant effect of the interaction between Time (pre-test, post-test, and follow-up) and Group (intervention and control) on Social inclusion ($F[2, 61] = 4.31, p = .018, \eta_p^2 = .12$), but not on Social exclusion ($F[2, 61] = 1.03, p = .363$) or Emotions ($F[2, 61] = .87, p = .422$). Post hoc tests with paired-samples t-tests revealed a non-significant difference from baseline ($M = 3.87, SD = .79$) to post-test ($M = 4.03, SD = .65$) for Social inclusion in the intervention group (Fig. 5).

Social validity. One-sample test analysis showed that children rated the serious game significantly higher than chance. The mean scores, based on the five-point scale, were 4.31 (CI: 4.00, 4.61; t

$[28] = 28.78, p < .001$) for the desirability of the game; 4.37 (CI: 4.20, 4.53; $t[26] = 53.75, p < .001$) for the feasibility of the intervention; and 3.53 (CI: 3.19, 3.88; $t[28] = 21.11, p < .001$) for the effectiveness of the serious game.

Discussion

This study tested the effectiveness of a serious game to improve psychosocial outcomes in children with VIs. Results revealed that the intervention had more positive effects on academic self-concept and social well-being compared with CAU. The children that played the serious game *See* scored significantly higher on academic self-concept compared with children in the CAU group. These findings represent an important, desirable outcome for children with VIs, in light of previous evidence indicating that individuals with VIs have lower academic self-concept compared with peers without VIs.⁴⁰ Academic self-concept is a critical aspect of personal development and academic achievement.⁴¹ Previous studies have shown that academic self-concept is positively related to academic achievement⁴² in higher education and that this relationship is mediated by intrinsic motivation.

According to the self-determination theory,⁴³ there are two types of motivation for engaging in tasks: intrinsic motivation, which is driven by one's interests and enjoyment, and extrinsic motivation, which is driven by external rewards. Based on our findings, it could be argued that engaging children in an educational, psychotherapeutic serious game offered an enjoyable setting and addressed children's intrinsic motivation to participate in the game. Accordingly, compared with traditional face-to-face interventions, this approach could ultimately improve the academic self-concept and future academic success of children with VIs through enjoyable tools, such as a game that relies on intrinsic motivation. What is more, this approach might prevent future

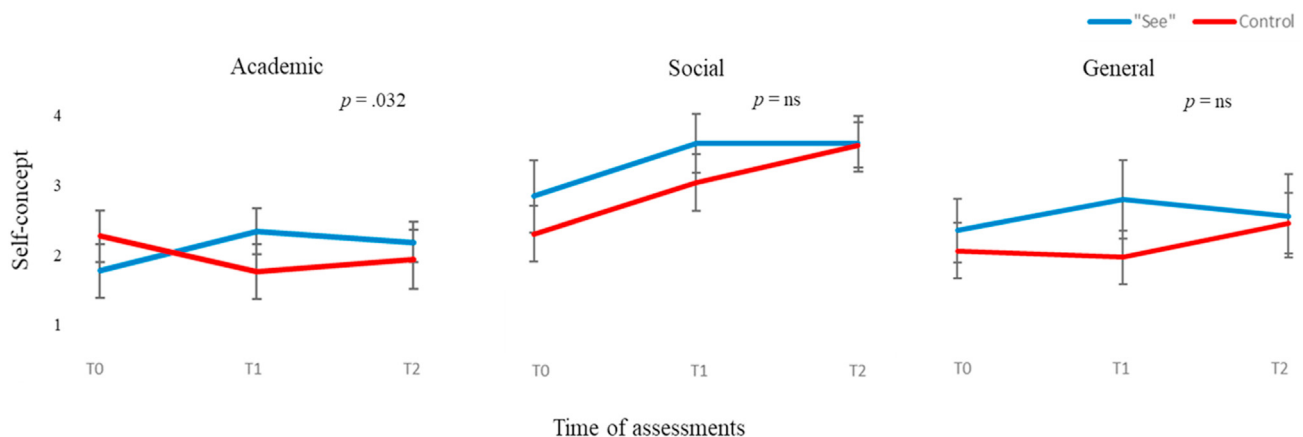


Fig. 3. Results of the repeated measures ANOVA with self-concept as the dependent variable. The y-axis represents self-concept scores; the x-axes represent the times of assessment (T0 = baseline, T1 = post-test, T2 = follow-up). Three aspects of self-concept are illustrated: Academic, Social, and General; blue: the intervention group condition (the "See" game); red: the control condition (Care-As-Usual). ns: no significant difference. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

negative academic and social-emotive outcomes. Additionally, the self-determination theory posits one's need for relatedness, in addition to competence and mastery, for optimal development.⁴³

Importantly, our study showed that children in the intervention group reported higher perceived social inclusion than those in the CAU group. This is a key finding in addressing the social well-being of children with VIs, as students with VIs were found to experience greater social challenges and less perceived social inclusion than children without VIs.⁴⁴ Furthermore, living with a VI has been associated with low levels of social participation and/or support,^{4–6,45} and with loneliness and depression in older individuals.¹¹

Furthermore, no significant effects of the intervention were found for social and general self-concept, compared with the CAU group. One possible explanation could be the specificity of the virtual game environments within the game See, which included solely academic environments, namely a classroom, a school, and a schoolyard. This exposure to specifically academic environments may have led to academic, but not social or general, self-concept improvements. Future games could be further improved by incorporating a wider range of environments to characterize more

aspects of children's real life. This would help to clarify if multiple environments within serious games lead to improvement in other aspects of self-concept, in addition to the academic self-concept documented in our study.

A non-significant difference emerged in avoidance coping strategy between the intervention and CAU groups. Yet, although these findings did not reach statistical significance, even the slightest improvement may nevertheless hold clinical significance. It could be that to observe a behavioral change (i.e., a coping strategy) might require more game sessions in comparison with a change in beliefs (i.e., self-concept). Alternatively, more effective changes might be promoted by distributing the 10 modules of the intervention over 10 sessions (i.e., one module per session), rather than delivering multiple modules (as many as the children wanted to play) in one session. Moreover, changes might be observed by allowing more time in-between sessions and practicing them in real-life situations. A noteworthy limitation of this study concerns the internal consistency and the test-retest reliability of the instruments used to assess children's psychosocial outcomes. This suggests that adaptations of already existing questionnaires (i.e., self-concept or the health-related quality-of-life questionnaires)

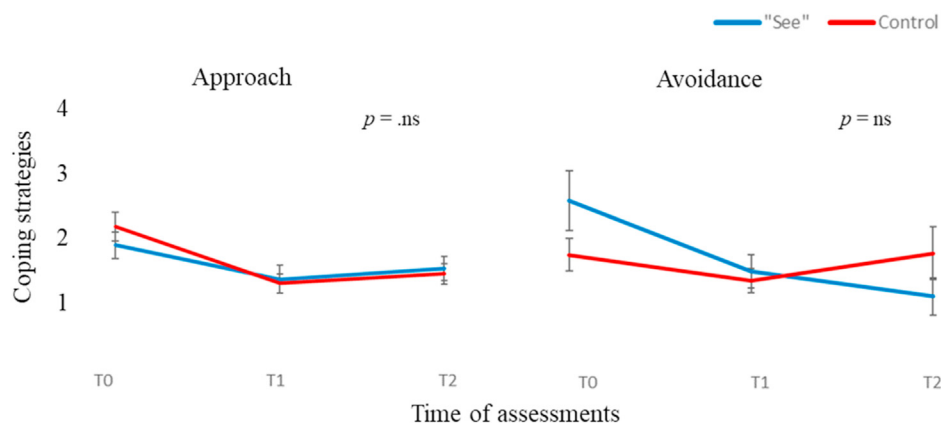


Fig. 4. Results of the repeated measures ANOVA with coping strategies as the dependent variable. The y-axis represents coping strategy scores; the x-axes represent the times of assessment (T0 = baseline, T1 = post-test, T2 = follow-up). Two coping strategies, namely approach and avoidance are illustrated; blue: the intervention group condition (the "See" game); red: the control condition (care-as-usual); ns: no significant difference. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

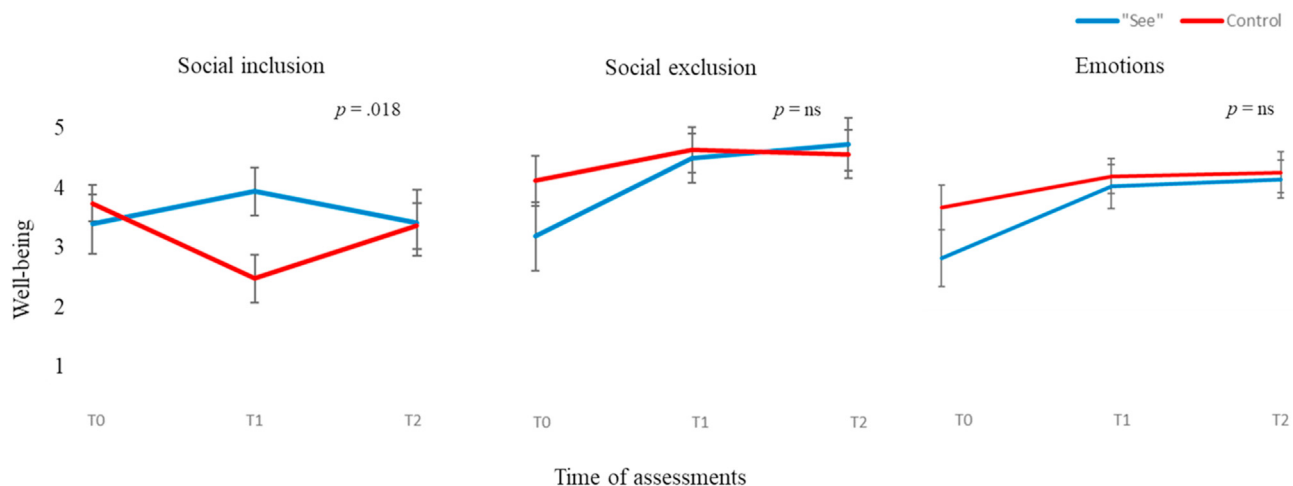


Fig. 5. Results of the repeated measures ANOVA with wellbeing as the dependent variable. The y-axis represents wellbeing scores; the x-axes represent the times of assessment (T0 = baseline, T1 = post-test, T2 = follow-up). Three aspects of wellbeing are illustrated, namely Social inclusion, Social exclusion, and Emotions; blue: the intervention group condition (the "See" game); red: the control condition (care-as-usual); ns: no significant difference. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

might be required for pediatric samples with VIs. It could be the case that poor test-retest reliability might have influenced our null findings, since some concepts, such as emotional well-being, were not consistent across the three assessments. With this in mind, replication studies using a wider range of instruments tailored to this population is warranted.

The serious game *See* was found to have a high level of desirability and applicability. The positive rating of the game indicated that this psychoeducational tool may be more appropriate than traditional therapies for reaching children who need psychological support in the school environment. A comparison study is still needed, however, to test the effects of this intervention compared with traditional face-to-face interventions. Yet, this study holds important implications for clinicians, teachers, and policymakers. An intervention for children with VIs conducted in an appealing way can benefit psychosocial outcomes. During early development, receiving an intervention in the form of an entertaining game might avoid forming negative thoughts about oneself. Moreover, a game might contribute to children's adherence and engagement with learning of new skills.⁴⁶ Our findings showed that children had a positive experience with the game, consistent with previous literature showing high levels of satisfaction in playing a serious game that incorporated REBT techniques for building emotional skills in children and adolescents.³¹ In addition, the benefits of an intervention implemented within an engaging serious game were attained, both at the individual level (i.e., facilitating positive outcomes) and at a broader level, because the game is easily accessible online, anywhere and at any time. Moreover, incorporating an evidence-based therapy, such as REBT,²⁰ into an entertaining serious game is an important advance in childhood mental health. This approach has the potential to foster positive outcomes and to increase engagement in interventions for children with VI, who might be otherwise unreachable by mental care services.^{25,47} Future work should also investigate whether playing the serious game results in lower perceived stigma compared with face-to-face interventions.

Although the intervention yielded positive effects on academic self-concept and social inclusion, replication is needed with larger sample sizes to substantiate these preliminary findings. For academic self-concept and perceived social inclusion, the overall trends suggest an increase from pre-to post-test in the intervention

group compared with the control group, yet this change was not maintained through follow-up. Hence, it is important to adapt the duration of the game and the frequency with which children play, as more game sessions might be required for sustained change in children's psychosocial outcomes. Additionally, caution should be exercised in the interpretation of our findings, given its sample size and the small effect sizes. Furthermore, taking into account the attrition rate in longitudinal clinical studies and the stratified design required to test interventions, an international study would be desirable. Altogether, this study revealed the effectiveness of the serious game *See* in benefitting children with VIs on academic self-concept and perceived social inclusion. Indeed, children rated the game positively and this represents a promising finding on which to base further testing of the implementation of this game on a larger scale.

Presentation

The serious game 'See' has been presented at the 6thECPVI by Yvonne Kruithof: <https://translate.google.com/translate?hl=nl&sl=hu&u=http://6ecpvi.elte.hu/Presentations.html&prev=search> and at the 9th ICEVI European Conference 2017 by Yvonne Kruithof: <http://semicomedia.be/icevi2017/ICEVI-abstracts.pdf>.

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Pieterneel Lievense and Yvonne Kruithof are developmental psychologists (orthopedagogen) at Bartiméus both have a masters degree. Natasja Bronzewijker and Marian Doeve are ambulant supporters for children with a visual impairment at Bartiméus. Victorita Stefania Vacaru is a researcher at the Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen and has a master degree. Prof. dr. Paula Sterkenburg is endowed professor of 'Persons with a visual or visual and intellectual disability; social relationships & ICT' at the Vrije Universiteit Amsterdam. This chair has been endowed by the Bartiméus foundation (Stichting Bartiméus) and the Bartiméus fund (Bartiméus Fonds) and is part of the academic lab Bartiméus - Vrije Universiteit Amsterdam (Academische Werkplaats Bartiméus- Vrije Universiteit Amsterdam).

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CRediT authorship contribution statement

Pieterneel Lievense: Formal analysis, Data curation, Writing - original draft, coordinated the data-collection, finalized the dataset. wrote the first draft. **Victorita Stefania Vacaru:** Formal analysis, Data curation, Writing - original draft, conducted the data-analyses. wrote the second draft. **Yvonne Kruithof:** Data curation, Writing - original draft, designed the study. developed the serious game. supported the data collection. wrote the first draft. **Natasja Bronzewijker:** Data curation, developed the serious game. supported the data collection. **Marian Doeve:** Data curation, developed the serious game. supported the data collection. **Paula Sophia Sterkenburg:** Writing - original draft, designed the study. gave advice during the game developmental process. wrote the second draft. finalized the manuscript.

Declaration of competing interest

The authors have no conflicts of interest to declare.

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